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## **Chapter 1**

# **Interdependence in Defense Technology**

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## Interdependence in Defense Technology

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### THE CONTEXT OF COLLABORATION

In the spring of 1989, Congress decided to permit General Dynamics Corp. to transfer F-16 fighter aircraft technology to Japan as part of an agreement with Mitsubishi Heavy Industries (MHI) to build an advanced fighter, the FSX. This deal differed from previous military cooperation that transferred defense technology to Japan because—for the first time—it involved *joint* development and production of a large-scale weapons system, funded by the Japanese Government, and using a Japanese company as the prime contractor.<sup>1</sup> It is also different because it took place against a backdrop of trade and technology issues that continue to strain relations between the two economic superpowers.

The debate over the FSX divided the Bush Administration, with the Department of Defense (DoD) defending the deal against critics in Congress, the press, and the Department of Commerce. Commerce officials and others asserted that advanced technology transferred to Japan would ultimately be used to penetrate civilian aviation markets, posing a new competitive threat to the American aviation industry. They questioned whether the FSX agreement was in the national interest, and specifically what technologies or other benefits the United States would receive in return. Others observed that in recent years, at the urging of the U.S. Government, the Japanese defense budget has risen to over \$30 billion, making it roughly equal to those of the major European powers: the United Kingdom, West Germany, France, and Italy.<sup>2</sup> They also expressed concern that the approval to build the FSX might constitute a step toward the remilitarization of Japan.

The prospect of U.S.-Japanese collaboration on the FSX also caused dissension within Congress, between factions that emphasized cooperation with our allies on one side, and those that sought to protect the defense industrial base and the commercial aerospace industry on the other. The debate made international collaboration with Japan a major issue in Congress and subjected it to national media attention. The question of how much and what kinds of technology the United States should transfer—and to which allies—became politically charged.

In the absence of a comprehensive policy, it is likely that the controversy over the FSX will be revisited the next time DoD negotiates a major codevelopment project with Japan. Security and trade issues, which had long occupied independent zones, have collided and will now have to be considered within a single policy framework. The argument that the United States should transfer technology to increase Japan's military capability and to strengthen ties between the two nations has lost its force. It is likely that trade and security issues will be more tightly coupled in the future, and that continued success of the U.S.-Japan security relationship will depend increasingly on the ability of the two nations to reduce economic confrontation and resolve outstanding trade disputes.

But Japan is not the only point of friction. Even before the FSX debate, the issue of collaboration with our NATO Allies had become more salient. With U.S. encouragement, the Europeans have developed very effective intra-European defense cooperation and, for many years, have configured their policies and defense industries to support it. There is considerable speculation that the Independent Euro-

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<sup>1</sup>The United States had previously transferred numerous military systems to the Japanese, such as the P-3C anti-submarine aircraft, the F-15 fighter, and the Patriot missile system, but these systems were developed in the United States, and then licensed for production in Japan and in other allied nations.

<sup>2</sup>Japanese military spending is technology intensive. In 1987, for example, Japan's defense budget was the sixth largest in the world, but Japan did not rank in the top 20 in terms of number of persons in its military services. U.S. Arms Control and Disarmament Agency, *World Military Expenditures*, #131 (Washington, DC: U.S. Government Printing Office, June 1989), p. 3.

pean Programme Group, an organization of European defense ministers, will assume the role of negotiating defense collaboration with the United States on behalf of a united Europe.

Collaboration in defense technology is a major issue in the context of restructuring the defense industries in the United States, Europe, and Asia to meet future threats with far smaller defense budgets.<sup>3</sup> The nature of the threat, the forces necessary to meet it, and the levels of defense funding are all uncertain. In these circumstances, it will be very difficult, both politically and economically, to retain the same defense industrial capacity (in the United States and in the NATO Alliance) that has been built up over the past four decades.

In the post-WWII period, the U.S. defense budget has averaged about \$270 billion a year in constant fiscal 1991 dollars. It has dipped as low as \$210 billion, following the Korean and Vietnam conflicts, thus establishing what might be termed a Cold War floor for defense expenditures (see figure 1-1).

The Reagan spend-up represented by far the largest peacetime budget increase in U.S. history. Many defense industry executives and analysts believe that the U.S. defense budget is now entering a period of free fall, similar to the post-Vietnam era of detente, with the difference that the Cold War has ended, and the perception of the Soviet threat in the public and among politicians is greatly reduced.

Much lower defense budgets will cause major changes and pains of adjustment for the defense industries around the world, particularly if such constraints are sustained into the foreseeable future. A comprehensive policy on international collaboration will be an integral part of deciding how to restructure the defense industries. A

sound policy would tell us how much defense industrial capacity to retain at home, how much to build in collaboration with our allies, how to allocate the burden of defense among the allied nations, and how to restructure the defense industries to do it.

Powerful factions within Congress have long expressed concern about the U.S. defense industries, particularly the second and lower tier defense contractors. Numerous statutes contain buy-American provisions, and an amendment to the Defense Production Act, proposed during the 101st Congress, would direct the President to limit within 5 years the production of existing and new weapons systems to domestic manufacturing and assembly sources. However, Congress continues to grant the Secretary of Defense authority to waive the Buy American Act, and has funded dozens of programs to stimulate R&D and possible codevelopment of new weapons with the NATO Allies under the Nunn amendment.<sup>4</sup> Indeed, there is a long history of collaboration between the United States and its European Allies, including coproduction of the F-16 fighter airplane by four nations, and the NATO AWACS, to name two prominent examples.

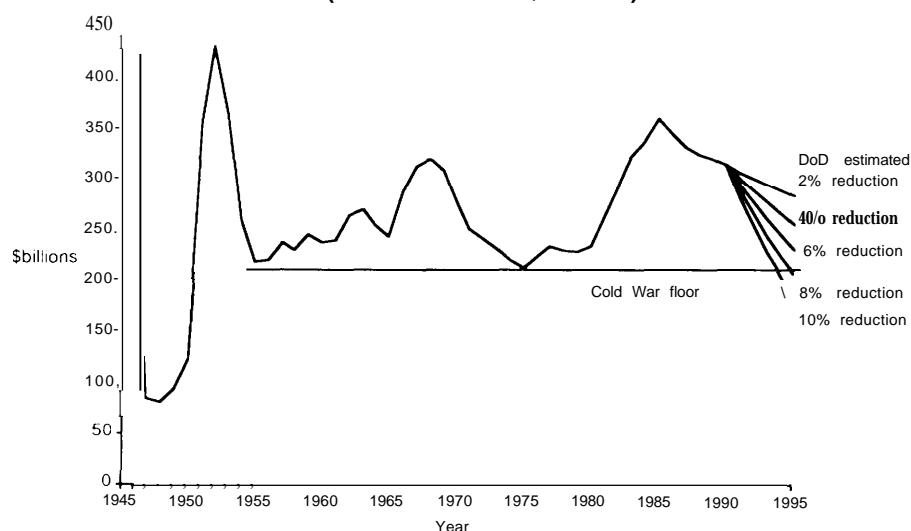
Few disinterested observers take the position that the United States can still develop, effectively and efficiently, all of the technology needed to build modern weapons systems; that period of weapons self-sufficiency was over even before the war in Vietnam. Much weapons technology is dual-use, that is, produced both for civilian markets and for military applications. Much of it is developed by large multinational companies with manufacturing facilities around the world. Part of the problem is our need to accept the fact that the leading edge of

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<sup>3</sup>The structure of the U.S. defense industries is analyzed in the following chapter.

<sup>4</sup>The Nunn-Roth-Warner amendment to the fiscal year 1986 Defense Authorization Act produced a budgetary commitment to NATO armaments cooperation for the first time, with \$100 million appropriated exclusively for NATO cooperative military R&D in fiscal year 1986, and an additional \$25 million appropriated for side-by-side testing of U.S. and Allied systems.

Figure I-I—Defense Department Budget Authority. 1946-95—Estimated  
(in 1991 constant \$ billions)



SOURCE: Department of Defense, and Office of Management and Budget, 1990.

technology does not always reside in the defense industries or even in the United States.<sup>5</sup>

Increasingly, internationalized patterns of industrial development are making irrelevant much of the debate over U.S. defense production. If DoD pursued a strict policy of procuring only from U.S. companies, it would be difficult to specify exactly what a U.S. company is. Would it be possible to find them in sufficient quantity and quality in the United States to sustain the defense industrial base?<sup>6</sup> Would a foreign-owned company be considered non-U.S. for defense purposes, even if it conducted most of its R&D, manufacturing, and sales activity in the United States? A great deal of technology already flows into U.S. defense systems from Canada, which in addition to being a member of NATO, is part of the North American Defense Industrial Base, and is tightly integrated with the U.S. economy through free trade agreements.<sup>7</sup> Many U.S. weapons systems

depend, partly by design and partly by chance, on Japanese and European technology, parts, and components. Interdependence in the defense industries is a fact of life and will continue to be in the 1990s and beyond.

Concurrently, the trend toward multilateral collaboration in defense technology has created what one analyst calls “class warfare” between the largest U.S. prime contractors and the thousands of smaller defense companies that depend on subcontracts from the primes to stay in business. The large aerospace and electronics defense companies, among others, favor policies that promote international collaboration, because it gives them the flexibility to team, subcontract, and form alliances with suppliers and partners around the world. This proliferates the number of different kinds of production arrangements that can be made, but more importantly, it increases access to foreign defense markets for the U.S. primes.

<sup>5</sup>See, for example, Defense Science Board, “Report of the Defense Science Board Task Force on Defense Semiconductor Dependency,” prepared for the Office of the Under Secretary of Defense for Acquisition, Washington, DC, February 1987; U.S. Congress, Office of Technology Assessment *Paying the Bill: Manufacturing and America's Trade Deficit*, OTA-ITE-390 (Washington DC: U.S. Government Printing Office, June 1988); and U.S. Congress, Office of Technology Assessment, *Making Things Better: Competing in Manufacturing*, OTA-ITE-443 (Washington DC: U.S. Government Printing Office, February 1990).

<sup>6</sup>OTA addressed these and related issues in U.S. Congress, Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, OTA-ISC-420 (Washington, DC: U.S. Government Printing Office, April 1989).

<sup>7</sup>Canada is considered part of the U.S. defense industrial base for all but a few highly classified DoD programs. This cooperation dates back to the 1940s, and has recently been reaffirmed by both nations.

Most of the smaller American defense companies are more parochial in their concerns. They specialize in doing defense business in the United States, and generally do not have the requisite knowledge or resources to enter into international business arrangements. These companies fear loss of business when a large U.S. company agrees to let a foreign firm build a major subsystem or component for a U.S. weapon system, because the foreign firm is unlikely to do business with suppliers in the United States. In this view, if a subcontract is awarded to a European or Asian firm, it is a zero-sum game, a lost opportunity for a U.S. company that may be extremely damaging to that company's future. They argue, moreover, that giving defense business to foreign firms erodes the U.S. mobilization base.

Consequently, many smaller defense companies support legislation that would force DoD to spend defense dollars at home. They argue that industrial policies of other nations strengthen the hand of foreign competitors, creating unfair advantages through subsidies, tax incentives, and low-interest loans. Nevertheless, the interests of the smaller companies may not be promoted by protection from the forces of globalization. In the FSX example, Japan agreed to let General Dynamics (GD) do 40 percent of **development** of the new airplane, and some unspecified amount of production, even though the U.S. Government does not plan to buy it.<sup>8</sup> GD is an obvious winner in the short term, but so are its U.S. subcontractors who will supply parts and components for the FSX fighters it produces. In this situation, GD acts as a conduit through which foreign work and money flows down into the U.S. defense industrial base.<sup>9</sup>

In the 1990s, some international collaboration in defense technology will be unavoidable and probably desirable. Ultimately, Congress will have to decide how much interdependence in defense technology and industry is prudent and

supportable; which allies should be favored and to what extent; what the United States should expect or demand in return for its technology; how best to support domestic development of critical technologies; and what kind of domestic defense industrial structure must be maintained to meet the future security needs of the United States. Having such decisions to DoD, to the defense industry, to chance, or to the vagaries of international defense markets could place the Nation's security at risk with catastrophic consequences. Moreover, congressional approaches that place constituency interests ahead of the national interest are potentially dangerous, as the Nation confronts dynamic new relationships in economic, political, and strategic security around the world.

Whatever the final policy determinations are, they will be taken against the backdrop of astonishing political upheaval in Eastern Europe and changes in the relationship between the United States and the Soviet Union. But sensational headlines about the end of the Cold War, the reunification of Germany, and the irrelevance of the NATO Alliance must not obstruct a reasoned analysis of significant trends that are already exerting pressure on the structure of military cooperation in the West. These include:

- increasing capacity and parity in the development and production of advanced weapons systems throughout Western Europe and the Western Pacific;
- overcapacity in many sectors of global defense industries;
- economic integration of Western Europe pursuant to the Single Europe Act;
- consolidation and contraction of the defense industries, both in Europe and in the United States;
- globalization of the defense industrial base; and
- decline in defense budgets.

<sup>8</sup>It is **highly** unlikely that any NATO country would permit a U.S. company to **codevelop** and produce a major weapons **system**, even **one based on** U.S. technology, if the U.S. Government did not share in the development and **procurement costs**.

<sup>9</sup>**General Dynamics used this circumstance** to political advantage during the **FSX** debate, asking its potential subcontractors to write members of Congress in support of the **FSX** deal.

These factors are already creating significant adjustment in the U.S. defense industries and in the structure of international collaboration; adjustments that will be accelerated by events in Eastern Europe.

## HISTORICAL PERSPECTIVE

In the first two decades following the Second World War collaboration in defense technology meant that NATO Allies bought defense equipment from the United States. As a consequence, nearly all NATO military technology and equipment initially incorporated U.S. specifications and standards. But the period of U.S. domination of these weapons markets and technology ended in the early 1960s, when the United Kingdom began to develop its first military airplanes of the post World War II period, and the French followed suit with domestically developed tanks and aircraft.

In the Western Pacific, cooperative defense programs have been an important element of U.S.-Japanese relations since 1954, when the Mutual Defense Assistance Agreement established the legal basis for the United States to supply Japan with military equipment and technology. Similarly, South Korea has purchased and continues to buy large amounts of U.S. military equipment since the end of the Korean War. Other forms of collaboration emerged with South Korea in the 1970s with the transfer of technical data packages to Korean defense firms, and in the 1980s, with licensing and coproduction of U.S. military systems such as the M109 howitzer and the F-5E fighter.

Intra-European codevelopment of weapons systems, particularly in aerospace programs, began in earnest in the middle to late 1960s. In 1965, France and the United Kingdom created a joint company, Sepecat, to build the Jaguar. In 1968, the United Kingdom, West Germany, and Italy established two new international concerns, Panavia (for aircraft) and Turbo-Union

(for engines) to build the Tornado, an advanced fighter for its time. In 1969, France and West Germany joined together to develop the Alpha jet. These early efforts at collaboration enabled the European powers to pool their defense industrial and financial resources, and to lessen their dependence on the United States for defense equipment.<sup>10</sup> They set the stage for the creation of a European armaments industry that by the 1980s produced military technology to rival that of the United States in many fields.

By the late 1970s, and with the support of Congress, most European countries had negotiated bilateral agreements, or memoranda of understanding (MOUs), with the United States that reduced trade barriers, specifically, waiving relevant buy-American statutes and regulations. By conservative estimates, in 1977 the trade imbalance in military equipment between the United States and Europe was 8 to 1 in favor of the United States. A decade later, that margin had decreased to less than 2 to 1. Beyond these direct, measurable sales, the United States depends on foreign defense companies for a large but unspecified number of parts and components, including communications systems, chemical defense equipment, and other items that employ a wide range of advanced technologies.

European nations are increasingly reluctant to buy military equipment from the United States, or even to build systems that were initially designed and developed here.<sup>11</sup> Instead, our NATO Allies seek to enter into codevelopment projects, with each nation funding a share of the costs of the system. Such relationships are common among the European nations, where the escalating costs of modern weapons systems long ago outpaced the ability and political will of most single countries to afford them. Insistence on developing part of a system also reflects the desire of the participating nations and companies to increase domestic defense

<sup>10</sup>The process of indigenization of defense capacity will be discussed in the chapter 2.

<sup>11</sup>This is due in part to their interest in building indigenous defense industrial capacity, and partly to U.S. technology transfer and security restrictions. The issue of U.S. unilateral export controls on military technology is addressed at the end of chapter 2.

industrial capacity, and at the same time, to position themselves to take advantage of commercial applications of new and evolving technologies. Many European defense companies also develop products for civilian high-technology markets.

Collaboration in the development and production of military technology and systems is an extremely complex enterprise, and it takes many different forms. Among governments, it includes information exchange, coproduction, co-development, security assistance, direct commercial sales, and other mechanisms. Some arrangements are open-ended, with virtually no commitments other than to talk. Others result in major financial investments and the transfer of critical know-how among nations. Pursuant to the 1986 Nunn amendment, the United States has entered into approximately 25 agreements to fund the initial R&D for new weapons systems jointly with one or more of its NATO Allies. These programs initially held great promise, and were seen as important in the context of strengthening NATO, both militarily and politically.

Although they constitute the principal means for DoD to encourage codevelopment with the European Allies, the Nunn amendment programs have encountered many difficulties and stumbling blocks. Several key programs will not go forward, including the NATO Frigate Replacement (NFR90), NATO Anti-Air Warfare System (NAAWS), Autonomous Precision Guided Munitions (APGM), and the Modular Stand Off Weapon (MSOW); and in others, such as the NATO Identification System (NIS) and Multi-Functional Information Distribution System (MIDS), one or more of the Allies has pulled out. While each failed attempt is a separate story, harmonizing military requirements among nations with different geographical and strategic concerns appears to be extremely difficult. This problem is likely to grow as the perception of the common Soviet threat to Europe declines.

Other factors, notably, the administrative complexities associated with meeting the regulations and requirements of two or more nations, have also created hurdles for the Nunn programs. When one nation pulls out, there is usually a domino effect, leading to abandonment of the program. In addition, there are indications that the U.S. military Services initially viewed the Nunn funding as an extra pot of money to be applied to projects that were of low priority to U.S. war-fighting capabilities.<sup>12</sup> Some industry analysts argue that, even if the surviving programs do make it past the development phase, there will not be sufficient funding in Europe or in the United States to go into production of low-priority systems. As the Nunn amendment programs have demonstrated, transatlantic government-to-government collaboration is a fragile process; and few programs have been successfully completed to date.

At the same time, direct collaboration between U.S. and foreign defense firms appears to be escalating. U.S. defense companies have entered into many different kinds of collaboration with their counterparts in other countries. These arrangements can take the form of direct subcontracting, joint ventures, teaming agreements, consortia, licensed production, offset agreements, data and personnel exchange, and many other financial and business interactions. Table 1-1 summarizes the different forms of collaboration.

The remainder of this chapter presents additional findings of this OTA Special Report. These findings are based on a review of the literature, interviews by OTA staff, and comments by outside experts. Chapter 2 expands on the findings and discusses the major issues related to international armaments cooperation. Chapters 3 to 5 and appendixes A through D contain the background material and analysis on which the findings are based.

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<sup>12</sup>The exceptions, such as NAAWS, APGM and the Surface Ship Torpedo Defense program, tend to prove the rule. But even here, the importance of the programs has not been sufficient to overcome the difficulties associated with government-to-government transatlantic collaboration.



**Table I-I—Forms of Collaboration in Defense Technologies**

Data and scientist/engineer exchanges . . . . .	Technology transfer through individuals.
Sourcing . . . . .	Direct purchase of a foreign-made part for a U.S. weapon system.
Subcontracting . . . . .	U.S. prime contractor contracts with a foreign company to develop or produce a portion of a U.S. system.
Licensing . . . . .	Selling or buying the rights to produce another firm's product.
<b>Foreign Military</b>	
Sales (FMS) . . . . .	Government sales of U.S. hardware abroad.
Coproduction assembly . . . . .	FMS with shared production and/or assembly.
Codevelopment . . . . .	Joint design, engineering and/or production.
Teaming . . . . .	Collaboration on a specific program as prime or subprime (also multiprogram teaming).
Alliances . . . . .	Loose agreements to collaborate in specific areas of technology.
Joint venture . . . . .	A jointly owned corporate entity to pursue a particular program or class of programs.
Consortium . . . . .	Loose agreement of several partners to pursue a technology area from shared resources with shared revenues.
Revenue sharing . . . . .	Joint activity where each partner invests in his area with agreement to share benefits/profits.
Acquisitions . . . . .	Outright purchase of a firm, either abroad or domestically.
"Family of Weapons" . . . . .	Agreement to minimize overlapping weapons development by cooperating, used by NATO.

SOURCE: Office of Technology Assessment, 1990.

## ADDITIONAL FINDINGS— Defense Industry and Technology

The principal findings of this Special Report are presented at the front in the section entitled *Overview and Principal Findings*. What follows are additional findings related to defense industry and technology in the United States, Western Europe, and the Western Pacific.

### *United States*

- Industry-to-industry or direct cooperation between U.S. and foreign defense companies is increasing dramatically. It has long been the preferred means of international arms collab-

oration, and can take almost as many forms as there are entrepreneurs willing to participate. The major incentive is economic. Industry seeks access to foreign markets, and deals will be structured so that participating companies make money and/or receive technical leverage, irrespective of national origins and loyalties. Industry-to-industry cooperation allows companies to make arrangements that are profitable and make sense for the corporate participants, but the national interest may not be fully factored into the economic equation.

- Overcapacity of the defense industries is increasing on a global scale. Major U.S. defense producers expect worldwide military funding to decrease over the next several years, and then to stabilize at much lower levels. This will cause intense competition, contraction, and restructuring in the U.S. and Allied armaments industries. Large U.S. companies are already rationalizing operations, laying off workers, seeking new markets, and forming strategic international alliances to weather the storm. U.S. subcontractors, who do not have these options, are likely to call for protective legislation, and many will leave defense work or go out of business.
- The United States can no longer expect most of its European Allies and Japan to buy or even coproduce major weapons systems that were originally designed and developed in the United States. Allies increasingly insist that collaboration take the form of cooperative development to enhance their domestic technology bases. They are especially interested in technologies that have significant civilian applications. Unlike many major U.S. defense companies, the European and Japanese counterparts have active interests in dual-use technology, stemming from their commitments to producing and selling in consumer markets.
- Large multinational Japanese and European companies that produce military systems may be able to withstand future defense budget

cuts better than their U.S. counterparts. They are also better able to absorb dual-use technology. This is largely due to their commitment to marketing, manufacturing, and selling consumer products. For example, MHI, Japan's largest defense producer, dedicates only 15 percent of its business to military production, as compared to GD's 85 percent and Lockheed's 95 percent.

- Foreign companies have acquired U.S. defense industrial base assets in recent years, and the trend appears to be increasing, although the precise extent of foreign penetration is unknown. Foreign defense companies increasingly seek strategic business alliances with U.S. partners or acquisition of firms located in the United States as a means to penetrate the U.S. market.
- If technology security and restrictive technology transfer policies are not reformed, they will damage the international business prospects of U.S. companies. Many of the reasons for which they were instituted have been obviated by diffusion of defense technology around the world, by recent political changes in Eastern Europe, and by the decrease in military tensions between the United States and the Soviet Union. On the other hand, as Third World conflict goes high-tech, controls on defense-related collaboration and technology transfer to Third World countries may become increasingly important and desirable. A national security review of U.S. export control policy has been ordered by the President, and major changes are expected in the Export Administration Act, which will be considered by Congress in September 1990.

### *Western Europe*

- Defense budgets in Western Europe have declined since the mid-1980s. With the rapid collapse of Communist regimes in Eastern Europe, further steep declines are anticipated. At the same time, the Europeans expect that increasing global overcapacity in the defense industries will result in fierce competition

with the United States-and perhaps eventually Japan and the newly industrialized countries-for shrinking defense markets in NATO and Third World countries. Many European nations, especially France, view arms exports as an important element in the overall trade picture.

- European defense industries have been restructuring through mergers and acquisitions to obtain the requisite size and technology base to meet this challenge. In the key aerospace and defense electronics sectors, the trend is for each major producer (i.e., France, Great Britain, Italy, and West Germany) to retain one or two integrated national champions. These firms are creating intra-European strategic alliances through stock swaps, joint acquisitions, and teaming on specific projects.
- Elements of national rivalry still exist among major European defense producers. At the same time, there is a strong trend toward governmentally sponsored intra-European defense industry cooperation, centered on the reactivated Independent European Programme Group (IEPG). European defense industry also benefits from a variety of government supported cooperative research programs in civilian dual-use technologies. EC 1992, while ostensibly excluding defense trade, will have a major impact in the defense area because most major European defense producers have important civilian sector interests.
- European industry considers access to the U.S. defense market to be essential, but many believe that the United States will eventually be closed to direct sales. Accordingly, there is increasing European interest in acquiring U.S. defense suppliers and in teaming arrangements with U.S. prime contractors. The full extent of European penetration of the U.S. defense market is difficult to ascertain, but there are indications of a significant increase in the past several years.

. As a forum for coordination of Allied defense industrial programs, NATO may have been weakened by the activation of the non-NATO IEPG, and the general increase in intra-European industrial cooperation. While all members of the IEPG are also members of NATO, the IEPG specifically excludes the United States and Canada. The 1986 Nunn amendment programs may be in jeopardy due to expected budget shortfalls, a general shift away from government-to-government collaboration, a redefinition of the military threat to Europe, and pressures toward pan-European defense programs.

### *Western Pacific*

- **The** United States and Japan have a long history of collaboration in defense technology, dating back to the Mutual Defense Assistance Agreement of 1954. Most cooperation has taken the form of coproduction, with Japanese firms producing equipment, initially developed in the United States, under licensing agreements with U.S. defense companies. The FSX codevelopment project represents a radical departure from the established historical relationship.
- . Japanese defense policies are changing in subtle and significant ways. Japan has dropped its requirement that defense spending be limited to 1 percent of GNP, although the 1 percent level is still approximately observed. In concert with Japan's GNP, Japanese defense budgets have expanded rapidly in recent years, partly in response to pressure from the United States to accept more of the burden of defense in the Western Pacific. In addition, the Japanese Government has modified its prohibition on the export of military equipment to permit the flow of defense technologies to the United States. Finally, Japan and the United States have recently reached a basic agreement to cooperate on the research for three militarily critical technologies. These changes have prompted concern over what some analysts have called the remilitarization of Japan.
- Important Japanese companies like Mitsubishi, Toshiba, and Nippon Electric made major investments in defense production in the 1980s, and Japan now produces over 80 percent of its weapons and military equipment domestically. Nevertheless, these companies allocate only a small percentage of production to defense. In Japanese companies, civilian technology flows easily into defense applications and vice versa.
- The United States increasingly depends on Japanese manufactured items to build its defense systems. The Department of Defense and U.S. defense firms purchase significant numbers of Japanese components for weapons systems assembled in the United States. The degree of such dependence is unknown, but there is general agreement that it is increasing, especially in the field of high-technology electronic parts and components. One U.S. defense company indicates that it conducted approximately 1 billion dollars' worth of business with Japan over a 3-year period.
- The FSX controversy has complicated any future collaboration between the United States and Japan in defense technology. In the United States, the press, the administration, Congress, and defense analysts will follow the deal closely for evidence of adverse economic impacts or bad faith on the part of the Japanese. In Japan, both industry and government officials question whether the United States will be a reliable partner in the future. Most analysts agree the FSX controversy damaged relations between the two countries.
- South Korea is attempting to develop a significant role for Korean defense firms as suppliers of military parts and components to major U.S. companies that produce defense equipment. This strategy is due in part to idle capacity (approximately 40 percent) in the Korean arms industry. In sharp contrast to Japan, Korean policy calls for export of arms and defense technology. This policy created

friction between the United States and Korea throughout the 1980s; in some periods, the U.S. Government has denied over 50 percent of South Korea's applications to export U.S.-origin technology to third countries.

- South Korea lags far behind Western countries and Japan in defense R&D. Korean firms have not yet devoted large resources to military R&D. Throughout the 1980s South Korean military R&D expenditures amounted to only about 1.6 percent of military budgets.
- It is not clear how the changes sweeping Europe and the Soviet Union will affect the security of the South Koreans. North Korea possesses a formidable threat with armed forces of over 1 million, an Army of over 800,000, 540,000 reserves that can be mobilized within 12 hours, 3,500 tanks, and over 4,000 heavy artillery pieces and rocket launchers. Given this threat, and their problems with U.S. technology controls in the 1980s, it is highly unlikely that the South Koreans will abandon their drive to develop an advanced defense industrial base in the near term, even though they have recently agreed in principle to normalize relations with the Soviet Union.
- The United States has signed memoranda of understanding regarding transfer of military technology with most of the Association of Southeast Asian Nations (ASEAN) countries. In part, the United States supplies Indonesia, Singapore, and Thailand with weapons systems and military technology to strengthen security ties with the ASEAN nations. These countries have all purchased F-16 fighters from the United States or have placed orders for them. They have not yet developed their indigenous military industries to a point where they could offer serious competition to U.S. companies.
- Australia purchases approximately 2 billion dollars' worth of U.S. military equipment and technology a year. They require a 30 percent offset for military purchases over \$200 million. Australia is developing a defense industry, but maintains that its purpose is not to compete with U.S. companies. Rather, they hope to build an indigenous capability to service equipment that is purchased from the United States.